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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
LAROSE, COLIN M	
ART UNIT	PAPER NUMBER
2623	7

DATE MAILED: 09/21/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/943,035	BOYKOV ET AL.	
	Examiner	Art Unit	
	Colin M. LaRose	2623	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-22 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-22 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 4.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. The following sections of 37 CFR §1.75(a) and (d)(1) are the basis of the following objection:

> (a) The specification must conclude with a claim particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention or discovery.
>
> (d)(1) The claim or claims must conform to the invention as set forth in the remainder of the specification and the terms and phrases used in the claims must find clear support or antecedent basis in the description so that the meaning of the terms in the claims may be ascertainable by reference to the description.

2. Claims 1-22 are objected to under 37 CFR §1.75(a) and (d)(1) as failing to particularly point out and distinctly claim the subject matter that the applicant regards as the invention.

Regarding claims 1 and 12, the claims define, "one or more object seeds" and "one or more background seeds." Then, these "one or more" seeds are connected to a source or sink node with "a plurality of t-links."

If there is only one object (or background) seed is it connected to the source (or sink) node with "a plurality" of t-links, as the claim suggests, or only one t-link, as the specification suggests? The claim seems to suggest that each seed is connected with a plurality of t-links, rather than only one t-link. Correction is required.

For the purposes of examination, it is presumed that each seed is connected to a respective node by only one t-link.

Analogous features appear in claims 6 and 17, and correction of these claims is also required.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 1-10 and 12-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent Application Publication by Nister in view of "Exact Voxel Occupancy with Grpah Cuts" by Snow et al. ("Snow")

Regarding claims 1 and 12, Nister discloses a method of/program storage device for segmenting one or more objects from one or more backgrounds in an image, the method comprising:

defining a plurality of image nodes, each said image node corresponding to one or more pixels of said image (figure 2: each of the 25 pixels constitutes an image node);

connecting pairs of adjacent nodes with n-links, each said n-link weighted with an n-link cost (figure 2: each of the pixels ("image nodes") is connected to its neighboring pixels with links that are weighted by a discontinuity cost; see paragraph 42);

defining a source node (figure 2: V_+);

defining a sink node (figure 2: V_-);

defining one or more "object" seeds; defining one or more "background" seeds, (figure 3: when a "graph cut" is effected, the pixels on either side of the cut are assigned to either the source node or the sink node, each of which corresponds to a different depth map; the assignment of each of the pixels to a different depth map essentially segments the image into two connective "depths" of the image;

in the conventional arrangement, one of the depth maps, usually the source, corresponds to an object or the foreground, while the other depth map, the sink, corresponds to the periphery or the background; thus, after cutting, each of the pixels is designated as an "object seed" or a "background seed" in that each pixel will either correspond to a foreground object or a part of its background;

however, Nister does not expressly disclose that, "said object seeds correspond to image nodes within said objects" and

"said background seeds correspond to image nodes within said backgrounds."

Snow (§ 5.2) shows that, conventionally, the source and sink nodes correspond to the "object" and "background" of the image, respectively, so that in assigning each of the image pixels to either the source or sink, the image foreground, or object, is left disconnected from the background. Snow illustrates that the source and sink correspond to different "depths" of the image, viz. an object and its background, and therefore, those skilled in the art would have known that Nister's source and sink nodes separate object from background in a similar manner);

connecting said source node with each said object seed with a plurality of t-links (i.e. every "object" pixel is connected to the source node via a link; see figure 3: those pixels linked to the source node V_+ are "object" pixels);

connecting said sink node with each said background seed with a plurality of t-links (i.e. every "background" pixel is connected to the sink node via a link; see figure 3: those pixels linked to the sink node V_- are "background" pixels);

wherein each said t-links is weighted with a t-link cost (i.e. each of the links between the pixels and the sink and source nodes is weighted; see paragraph 42); and

calculating a segmentation cut having the smallest total cost of all cuts separating said source from said sink, wherein said total cost of each said cut is defined as the sum of the costs of all said n-links and t-links that each said cut severs (paragraph 44: generating a "graph cut" that segments the image is determined as a cut that minimizes the energy costs; in particular, the energy cost is determined as the sum of the costs of all links that are to be broken --- figure 3 illustrates the four scenarios that arise when a cut is to be made between two pixels; the costs associated with each cut are calculated as the sum of all links that are broken; the optimal cut is the one that minimizes the overall cost).

Regarding claims 2 and 13, Nister discloses the method of claim 1 wherein said n-link cost is a function of a local intensity gradient between said image nodes (paragraph 42: "discontinuity" between pixels).

Regarding claims 3 and 14, Nister discloses the method of claim 2 wherein said n-link cost is the function $f(|I_p-I_q|)$, where, where I_p and I_q are the intensities of image nodes p and q respectively and f( ) is a non-negative decreasing function (paragraphs 15-18: the energy E of the links is a function of the Gaussian distribution f(Y, U, V), which denotes the probability of adjacent pixels

being discontinuous in terms of intensity Y and chrominance U & V; The Gaussian distribution is non-negative and decreasing function that is a function of the absolute value of the difference in adjacent pixel values).

Regarding claims 4 and 15, Nister discloses the method of claim 3 wherein said non-negative decreasing function $f(x)=(K)\exp(-x^2/\sigma^2)$ (paragraphs 15-18: the Gaussian distribution utilized by Nister in paragraph 15 is substantially the same as the claimed function; both represent the well-known Gaussian distribution).

Regarding claims 5 and 16, Nister discloses the method of claim 1 wherein said t-link cost between the source and the object seeds and between the sink and the background seeds is infinity (i.e. when the graph cut is effected and all of the pixels are assigned to either the source or sink node, thereby designating them as object or background seeds, respectively, the links between the pixels and their respective node are thought to be fixed; that is, once the assignment has been completed via the graph cut, then the links are substantially infinity due to the fact that they are not to be broken).

Regarding claims 6 and 17, Nister discloses the method of claim 1 further comprising: connecting said source node with each said image node with a plurality of t-links; and connecting said sink node with each said image node with a plurality of t-links (see figure 2).

Regarding claims 7 and 18, Nister discloses the method of claim 6 wherein said cost of each said t-link not connected to a seed is a function of the probability that the image node to which said t-link is connected belongs to predefined object and background distributions (i.e. Nister's links between each of the pixels and the source and sink nodes are functions of the probability of each pixel belonging to the associated node; the energy of the links is based on the Bayesian (or "maximum a posteriori") probability metric; see paragraphs 10-12 and 18).

Regarding claims 8 and 19, Nister discloses the method of claim 1 wherein additional seeds may be defined after calculation of said segmentation boundary and a new segmentation boundary recalculated (paragraph 59: the assignment of the pixels as object or background "seeds" may follow an iterative process wherein additional seeds can be defined after recalculation of the cut boundary).

Regarding claims 9 and 20, Nister discloses the method of claim 8 wherein additional seeds are defined near a region where two objects are in contact so as to separate them upon recalculation (paragraph 59: additional seeds are defined and re-defined for the entire image, including such a region).

Regarding claims 10 and 21, Snow discloses calculating of the segmentation boundary is conventionally effected with a max-flow method (§ 4.1).

6. Claims 11 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nister in view of Snow, as applied to claim 1 above, and further in view of "A New Approach to the Max-Flow Problem" by Goldberg et al. ("Goldberg").

Regarding claims 11 and 22, Snow, as indicated for claims 10 and 21, discloses that the calculating of the segmentation boundary is conventionally effected with a max-flow method. However, Snow is silent to the claimed push-relabel method.

Goldberg discloses the push-relabel method as an improvement on the max-flow method. One skilled in the art would have been motivated to utilize Goldberg's push-relabel method since it improves upon the max-flow method disclosed by Snow. Therefore, the use of the push-relabel method would have been obvious to those skilled in the art.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

U.S. Patent 4,905,148 by Crawford for specifying object and background seeds in a 3-D segmentation scheme.

U.S. Patent 6,744,923 by Zabih.

"Graph Cut: Application to Bayesian Emission Tomography Reconstruction" by Bonneville et al.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Colin M. LaRose whose telephone number is (703) 306-3489. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au, can be reached on (703) 308-6604. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the TC 2600 Customer Service Office whose telephone number is (703) 306-0377.

CML
Group Art Unit 2623
14 September 2004

VIKKRAM BALI
PRIMARY EXAMINER